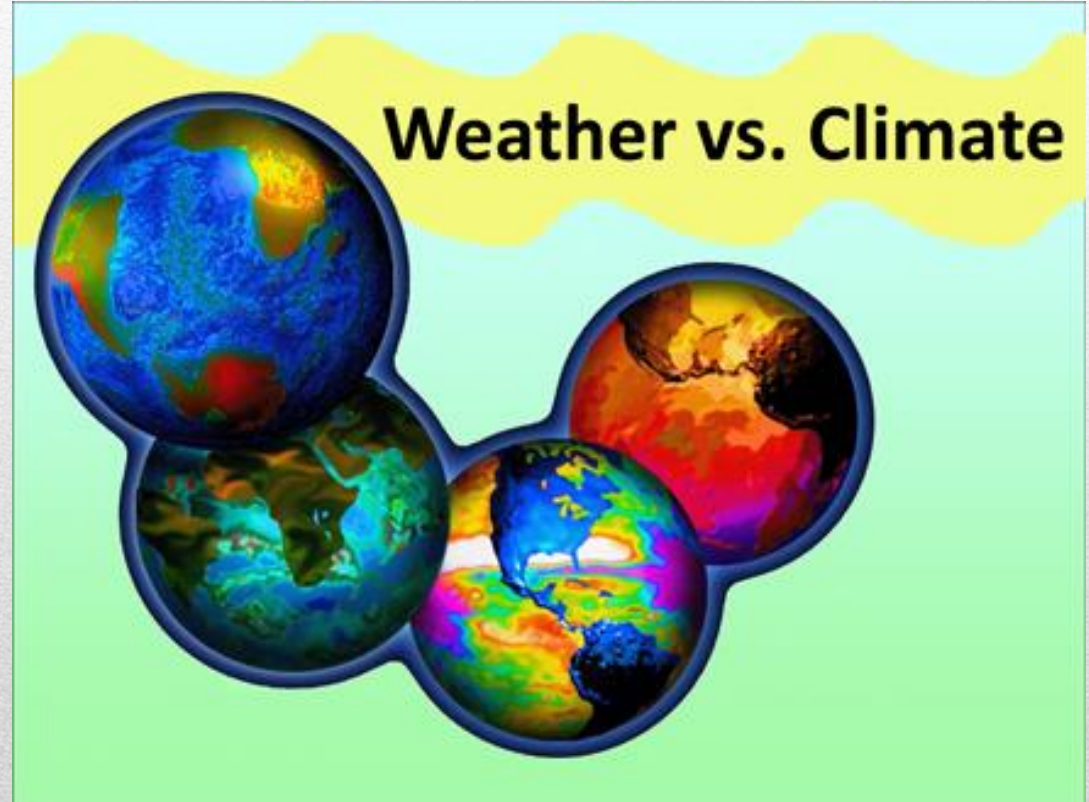


Introduction to the Atmosphere

Chapter 3

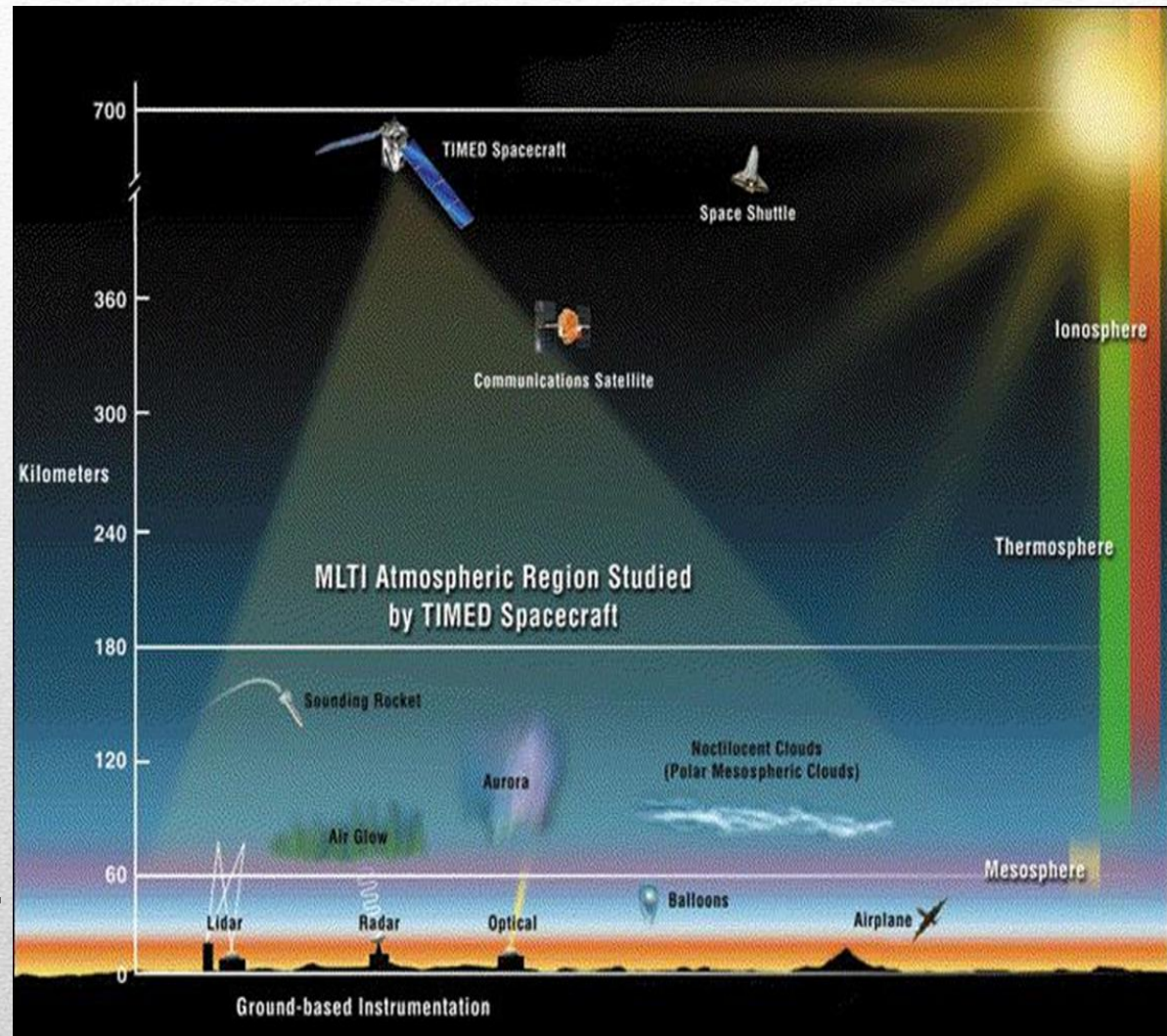
Atmosphere, Weather and Climate

- General Composition of the atmosphere
 - Temperature
 - Pressure
 - Wind
 - Moisture
 - Weather --Flows and Disturbances
 - Climate -- Zones and Types
-



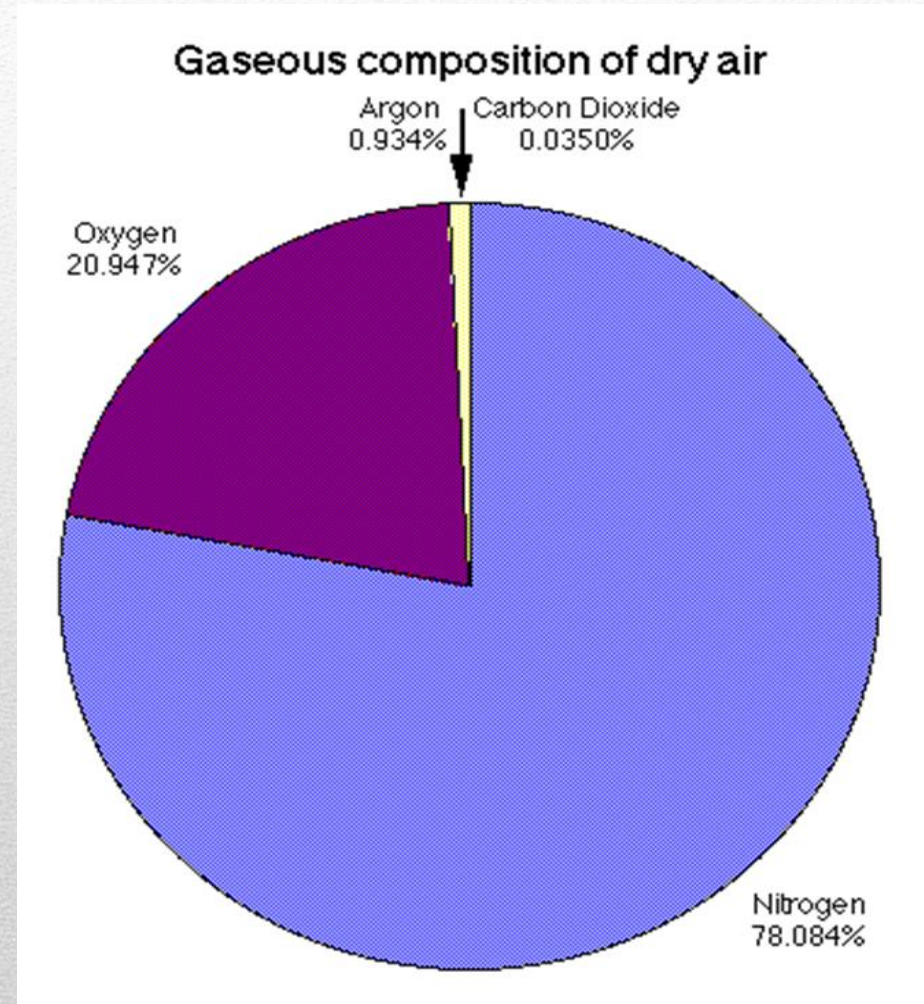
Size of the Earth's Atmosphere

- Extends outward at least 6000 miles
- More than half of the mass of the atmosphere found below 3.8 miles
- More than 98% lies with 16 miles of sea level
- Humans are creatures of the atmosphere



What is the composition of the Atmosphere

- Permanent Gases
 - Nitrogen and Oxygen
 - make up the 99 % of the atmosphere
 - 78% Nitrogen
 - 21% Oxygen
 - Other 1%
 - Argon .9%
 - Carbon Dioxide .038%
 - All other gases .06%
equaling .998%



Other Significant Gases

- Water Vapor

- Invisible

- Visible

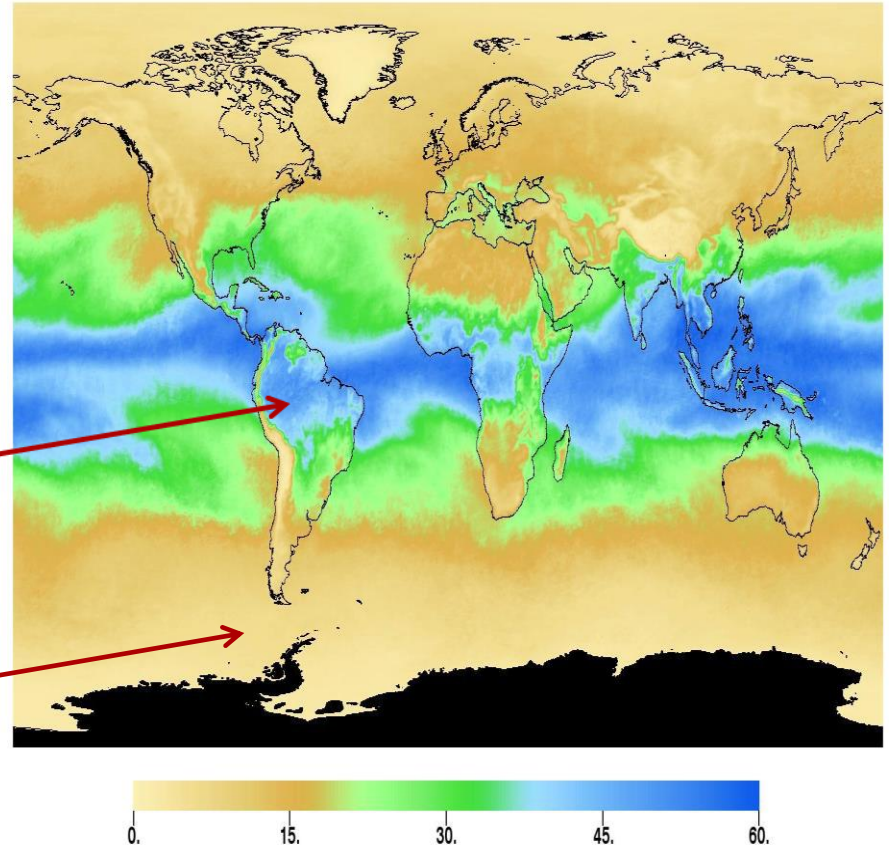
- Clouds

- Precipitation (liquid or solid)

- Abundant in air overlying warm, most surface areas, like tropical oceans measuring up to as much as 4% of the volume of the air mass

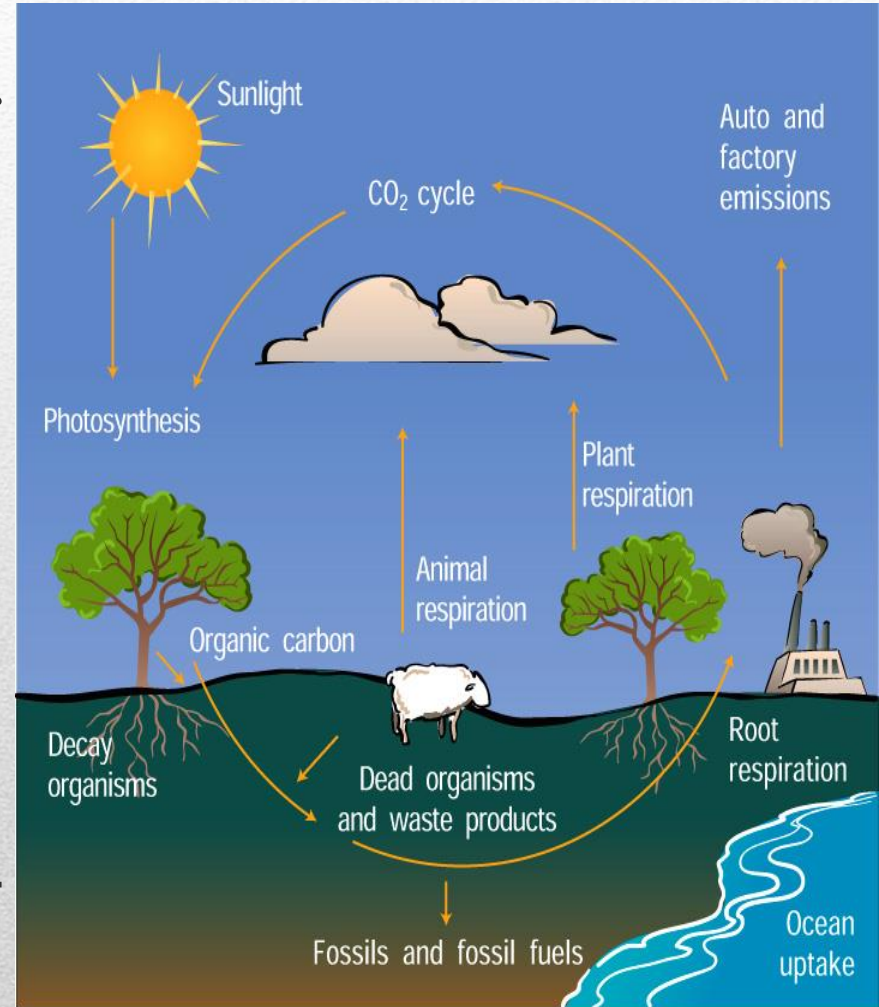
- Over deserts or polar regions it would make up less than 1% of the volume

AIRS TOTAL PRECIPITABLE WATER VAPOR (mm), May 2009



Other Significant Gases

- Carbon Dioxide (CO₂)
- Significant to the climate because of its ability to absorb infrared radiation, which helps warm the lower part of the atmosphere
- Distributed evenly throughout the lower atmosphere
- Increasing during the last century at a rate of about .0002 percent
- Increased levels of Carbon Dioxide are causing the lower atmosphere to produce somewhat unpredictable climate changes (global warming)



Other Significant Gases

- Another minor vital gas in the atmosphere is Ozone
 - Mostly concentrated in the Ozone layer
 - Between 9 to 30 miles above sea level
 - Ozone is excellent as an absorber of ultraviolet solar radiation and its deadly effects.
 - Other variable gases include
 - Carbon monoxide, sulfur dioxide, nitrogen oxides, and various hydrocarbons
 - All hazardous to life and may possibly effect the climate
-

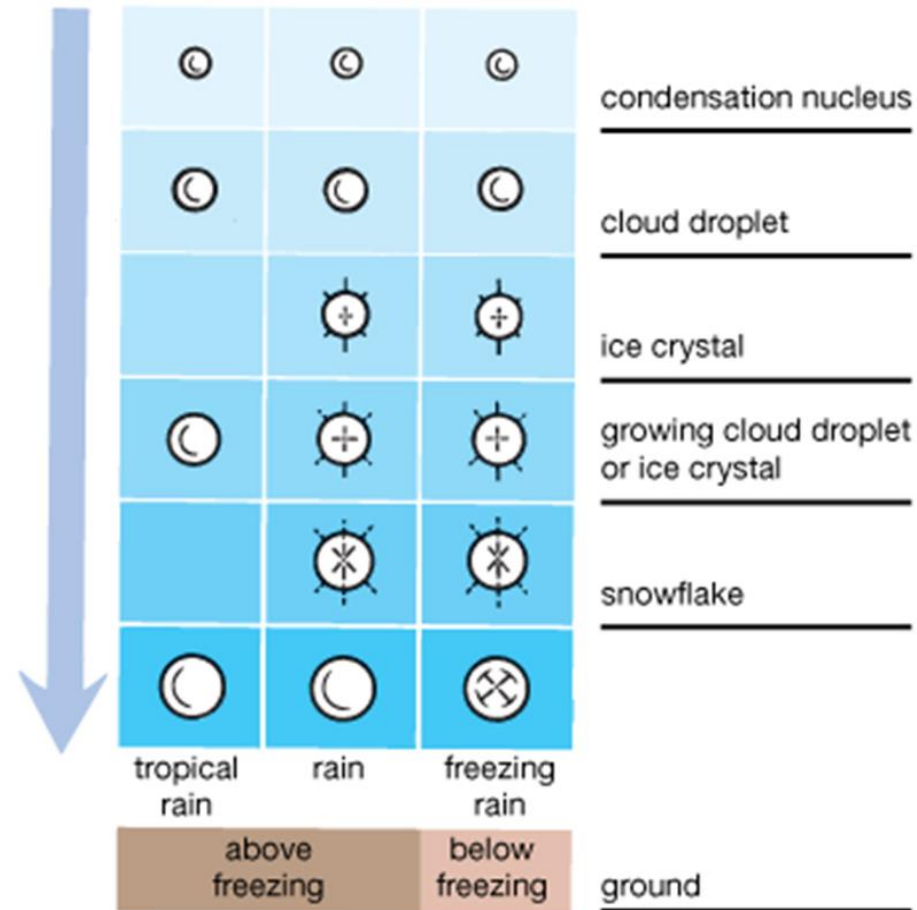
Particulates (Aerosols)

- Large nongaseous particles in the atmosphere
 - Mainly liquid water and ice
 - Clouds, rain, snow, sleet, and hail
 - Dust particles large enough to be visible, but too heavy to fall to the ground
 - Smaller particulates are invisible to the naked eye, may also be suspended in the atmosphere
 - Found near their origin, either urban areas, or the natural condition that caused the particulate
-

Affects on Weather and Climate

- Many of the particulates are hygroscopic (absorbs water)
 - The water vapor condenses around the particulates as they float by
 - Accumulation of water vapor molecules is a critical step in cloud formation
- Some either absorb or reflect sunlight, thus decreasing the amount of solar energy that reaches Earth's surface

Development of a raindrop



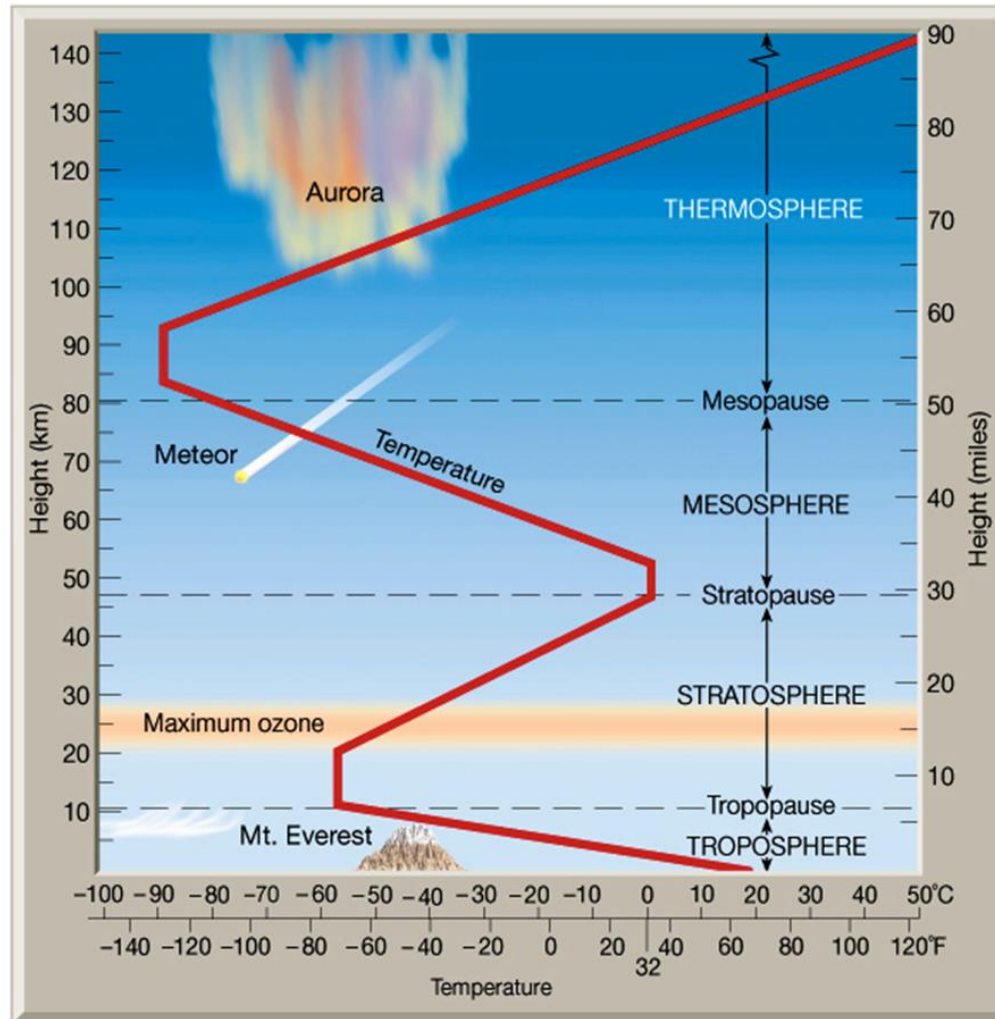
Structure of the Atmosphere

- Lower thermal layers of the atmosphere
 - Troposphere and Tropopause
 - Lowest level, closest to sea level
 - 11 miles at equator to 8 miles at poles
 - Varies with the passages of warm and cold air
 - It is the layer of Weather and Climate
 - The temperature decreases with the increase of altitude
 - Stratosphere and Stratopause
 - Extends from 11 miles above sea level to 30 miles above sea level
 - The temperature increases with the increase of altitude
-

Structure of the Atmosphere

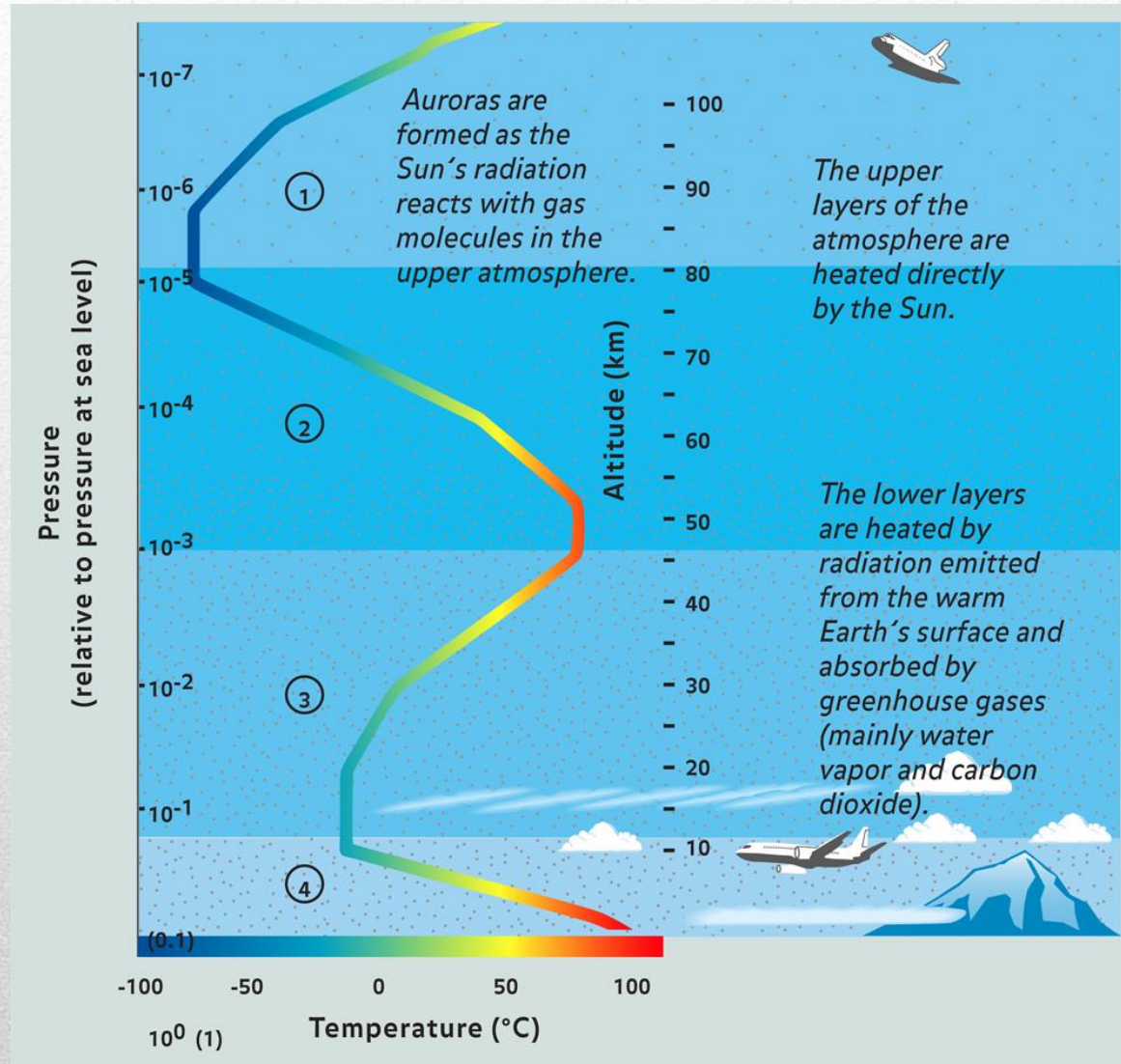
- Upper thermal layers of the atmosphere
 - Mesosphere and Mesopause
 - Begins 30 miles and ends 50 miles above sea level
 - The temperature decreases with an increase in altitude
 - Thermosphere
 - Begins at 50 miles and gradually extends out 125 miles
 - Temperature increases with an increase in altitude
 - Exosphere
 - Outer most portion of the atmosphere
 - Blends with interplanetary space
 - No concept of temperature
-

Structure of the Atmosphere



Warm Layers/Cold Layers

- Warm Layers
 - Layers that have a specific source of heat
 - Troposphere:
 - The Earth is the source of heat for this layer
 - Top of the Stratosphere:
 - The Ozone layer which is found within this layer absorbs ultraviolet rays , thereby warming this layer
 - Cold Layers
 - Layers that don't have the warming sources
-



Two other Vertical Compositional Layers

- Ionosphere

- 40 to 250 miles above sea level
- Deep layer of electrically charged molecules and atoms
- Aids in the reflecting of radio waves back to earth
- Is also known for its *auroral displays* or the **Northern Lights**
- Found in the **Thermosphere**

- Ozoneosphere

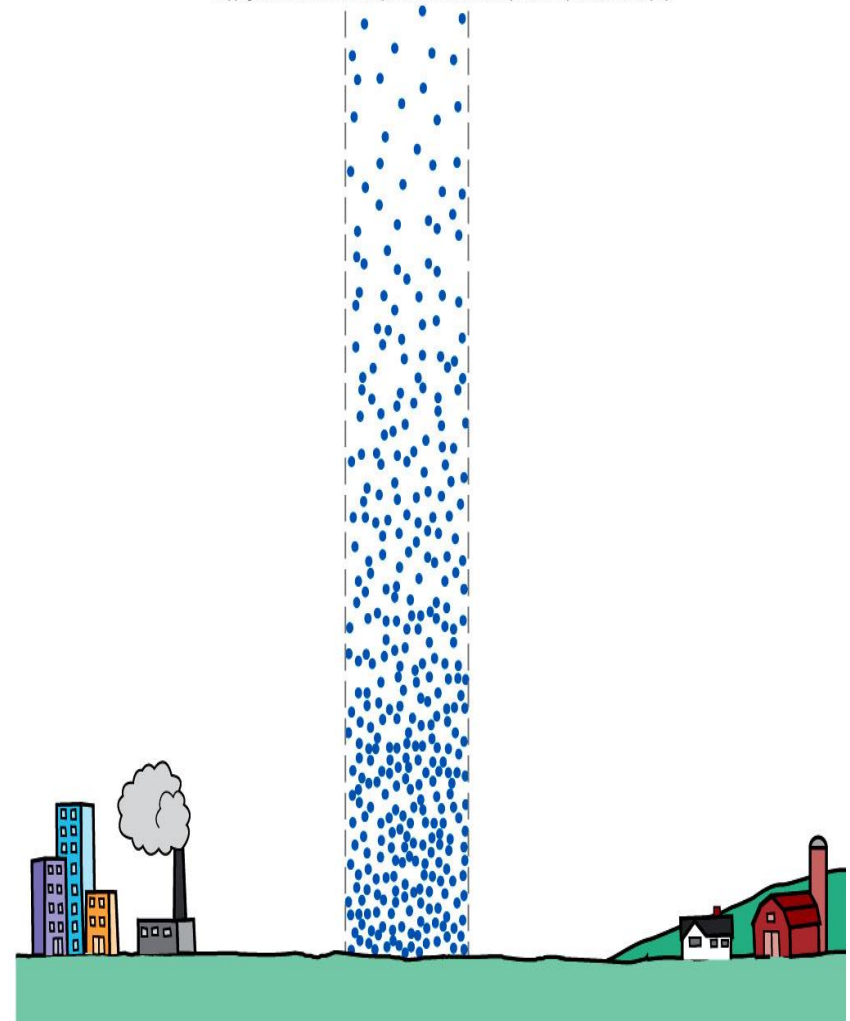
- 9 to 30 miles above sea level
- Gets its name because the **concentration of ozone is at its highest**
- Found in the **Stratosphere**



Pressures

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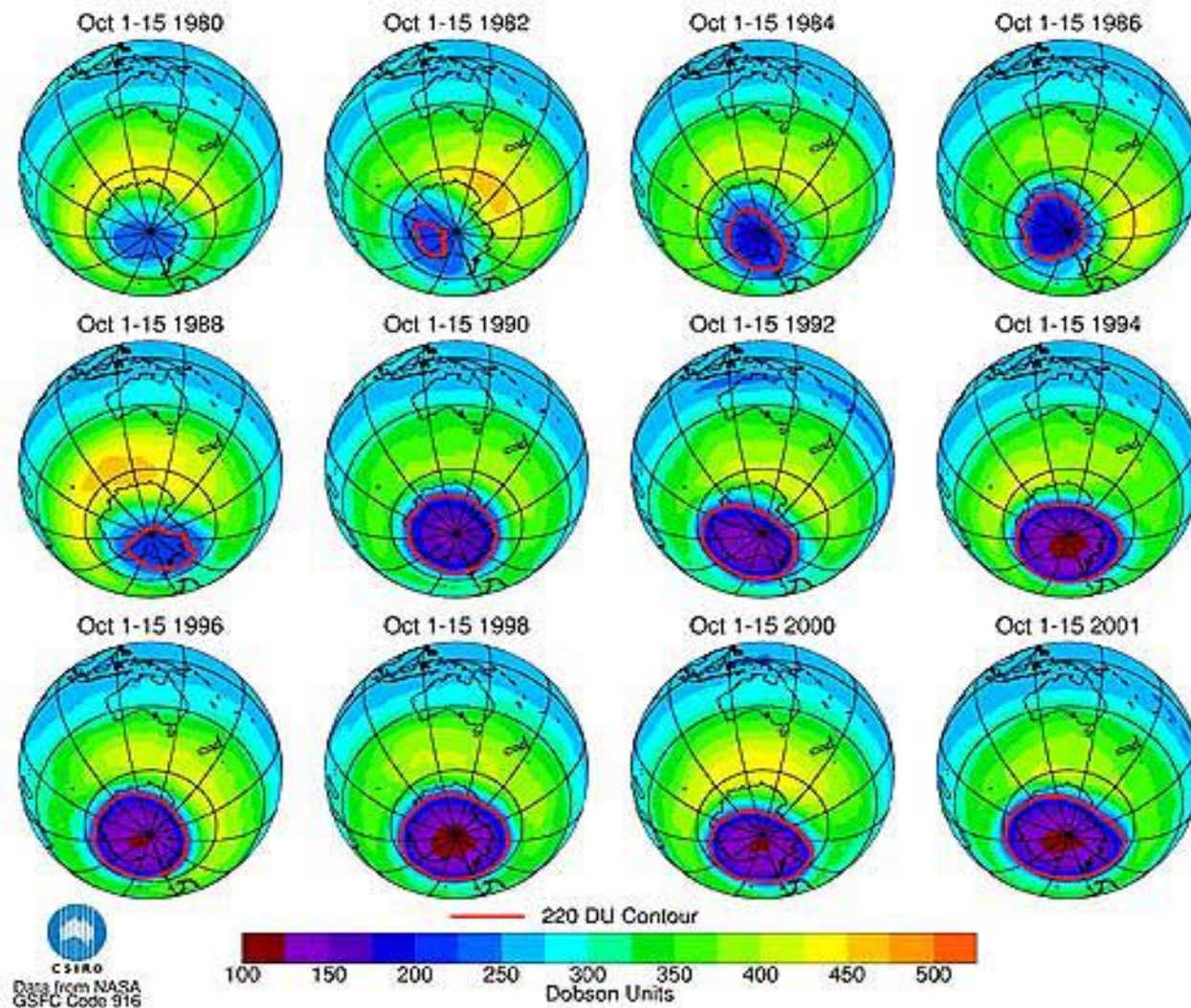
- Atmospheric pressures are simply the “weight” of the overlying air.
- The taller the column of air the greater the pressure.
 - So at sea level, the column of air above is longer thus the air pressure is higher, and the air is denser
 - At a high altitude there is a smaller column of air, so the air pressure is lower and the air is less dense.
- The decrease in air pressure decreases with altitude but not at a constant rate.



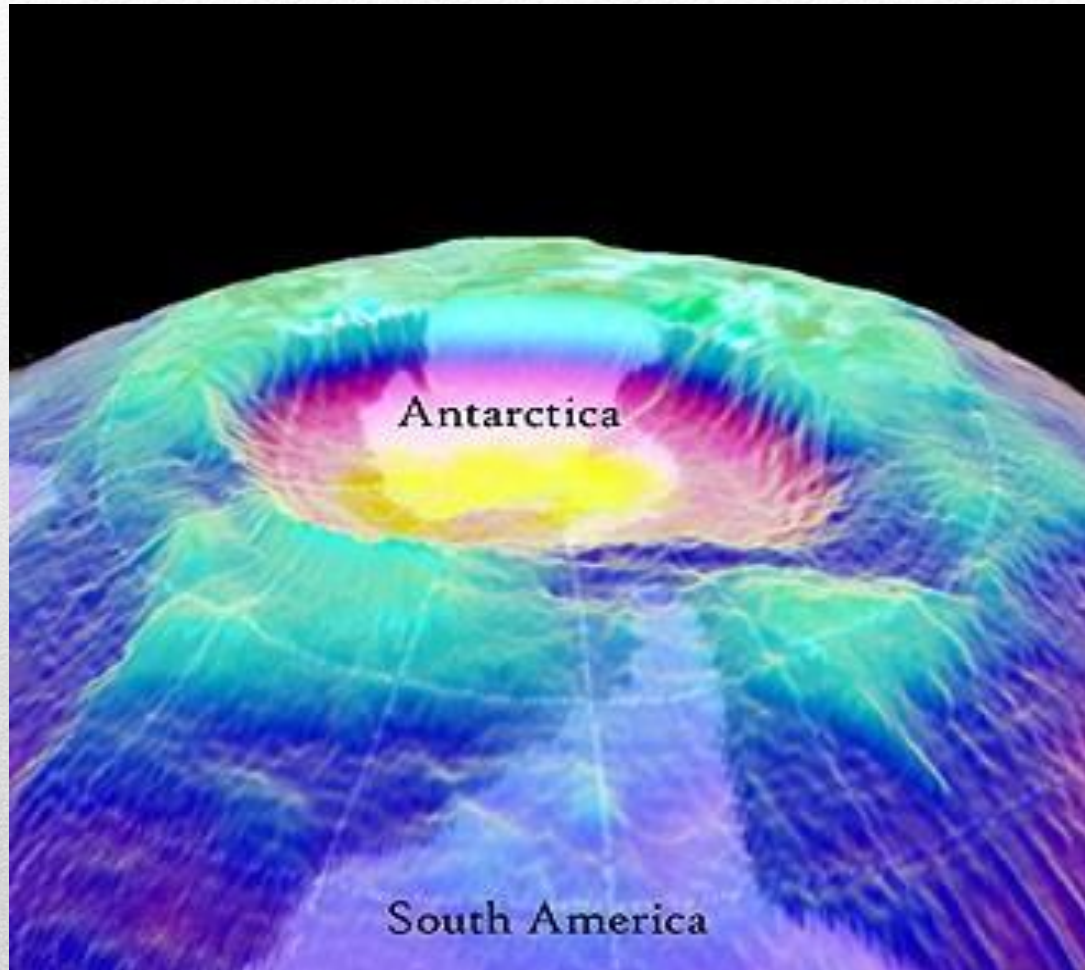
Human-Induced Atmospheric Change (What have we done?)

- **Depletion of the Ozone Layer**
 - **Hole in the Ozone Layer**
 - **Chlorofluorocarbons most problematic chemicals** used by humans that depleted the Ozone.
 - **Thinning of the Ozone Layer allows for Ultraviolet rays to reach the surface of the earth**
 - In the polar areas of the earth (Antarctica), the ice crystals create a place for chlorine based molecules to form. In the spring they trigger a catalytic reaction and the Ozone is depleted even more than in the other latitudes
-

Growth of the Hole in the Ozone Layer

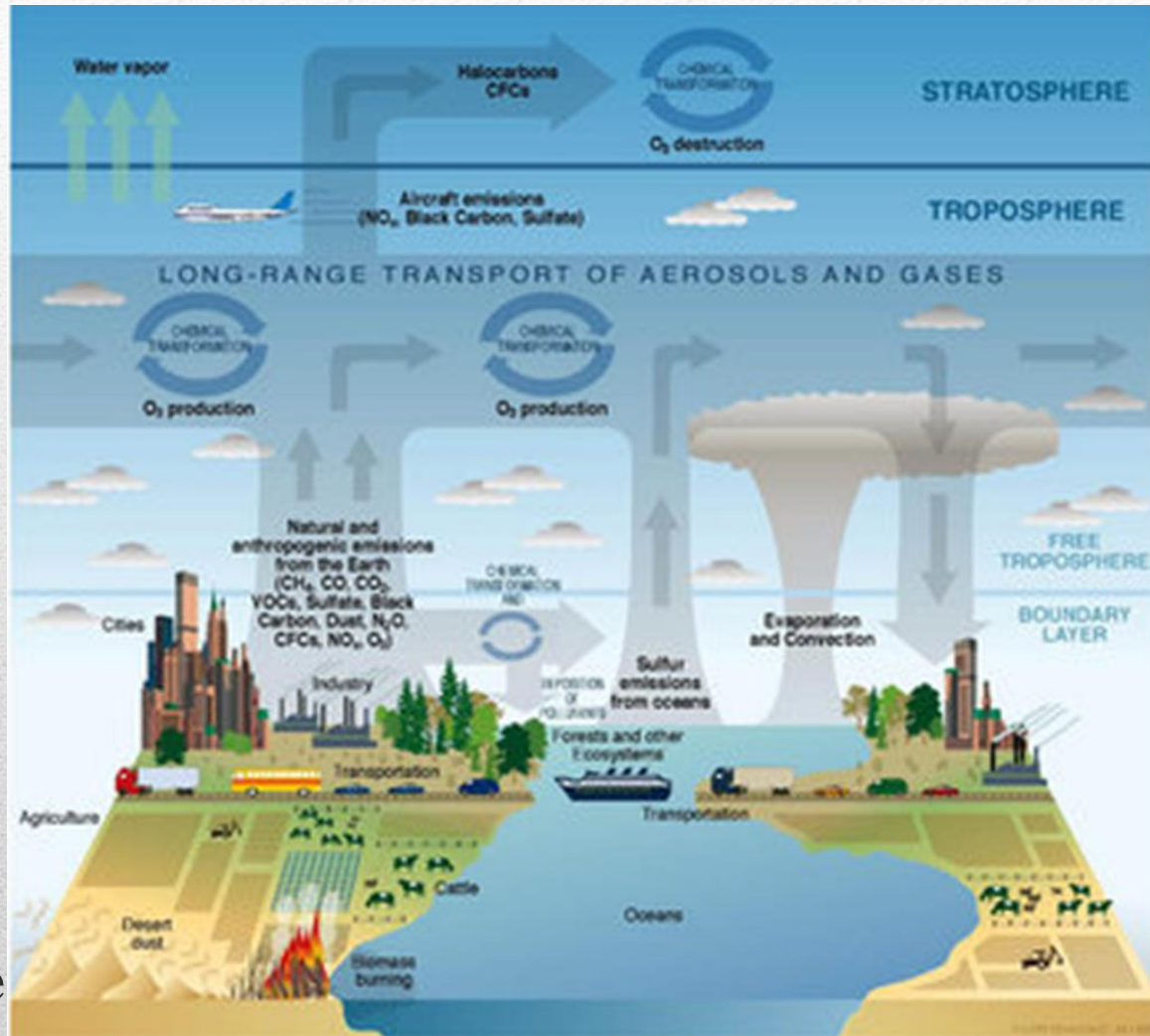


Hole in the Ozone



Air Pollution

- Smoke
- Sulfur Compounds
- Nitrogen Compounds
- Photochemical Smog
- **Consequences of Anthropogenic Air Pollution**
 - Damages our health
 - Damages the plant life



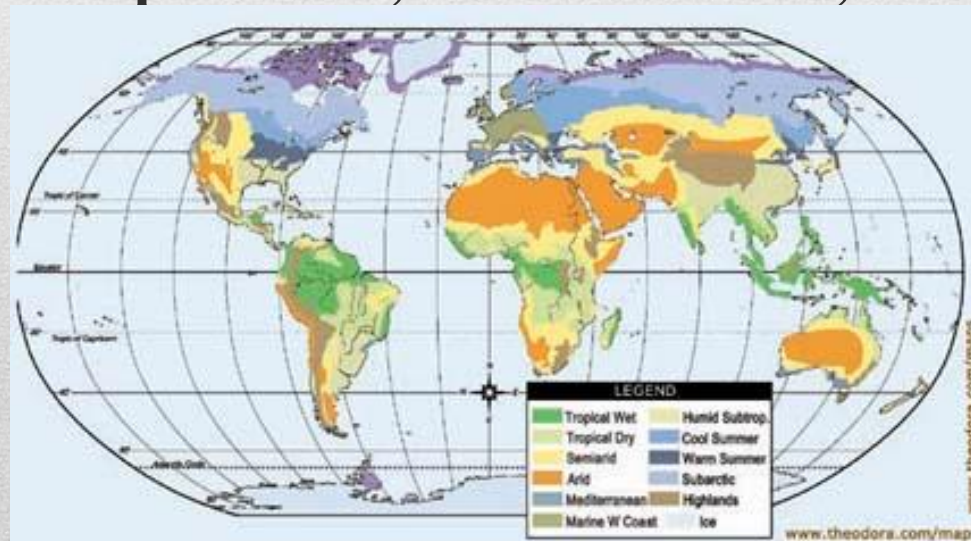
Weather

- Weather...
 - Short-run atmospheric conditions that exist for a given time in a specific area
 - The sum of temperature, humidity, cloudiness, precipitation, pressure, winds, storms, and other variables for a short period of time
 - Weather is in an almost constant state of change



Climate

- Climate.....
 - The generalized variations of the weather
 - The aggregate of day-to-day weather conditions of a long period of time.
 - Has averages, variations and extremes
- Weather and Climate have direct and obvious influences on agriculture, transportation, and human life, and the physical land



Four Elements of the Weather and the Climate

Temperature



Wind



Pressure



Moisture



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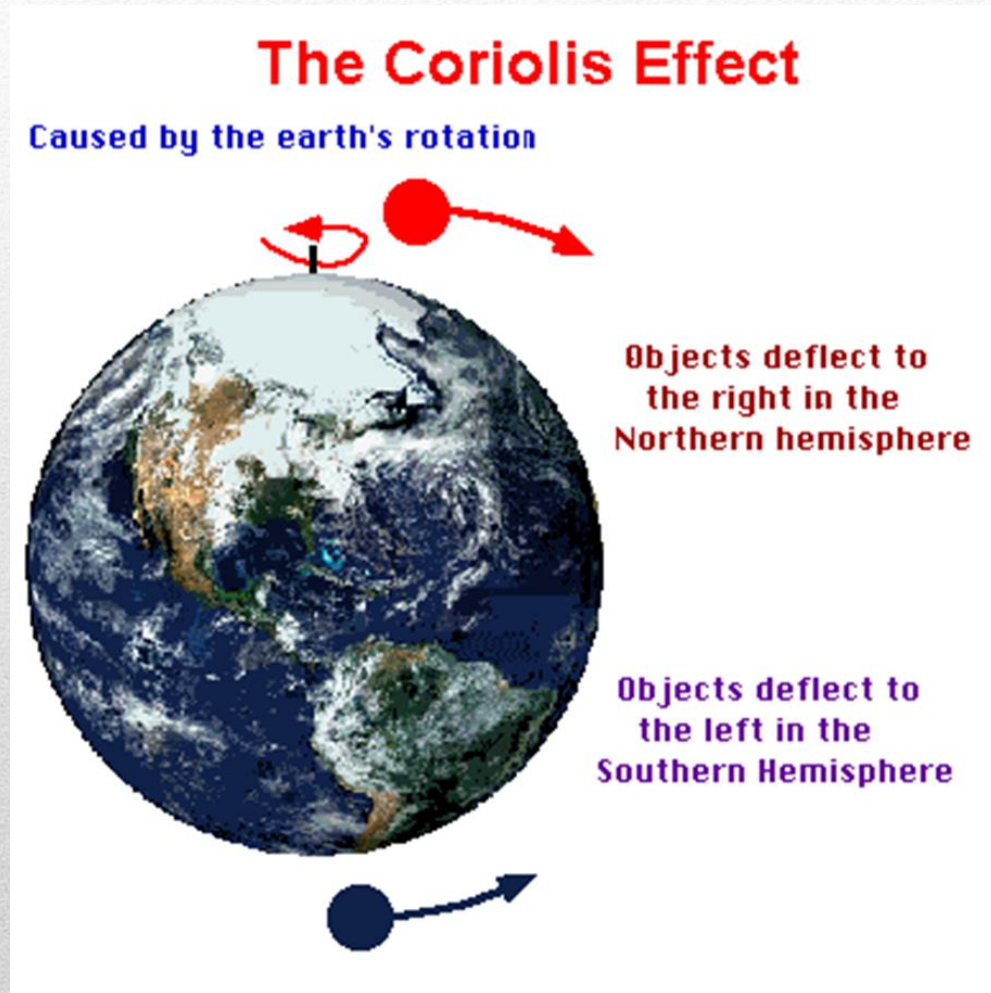
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Controls of the Weather and Climate

- Latitude
 - Distribution of Land and Water
 - General Circulation of the Atmosphere
 - General Circulation of the Oceans
 - Altitude
 - Topographic Barriers
 - Storms
-

The Coriolis Effect or Force

- Appearance of all things **drifting sideways** as a result of the Earth's rotation.
- Why? If a rocket is shot directly at New York, by the time the rocket arrives at New York, the Earth has rotated and the rocket seems to have “**drifted**”
- Applies to any freely moving object.



Four Basic Points of the Coriolis Effect

1. **Regardless of the initial direction of motion**, any freely moving object appears to deflect to the right in the **Northern Hemisphere** and to the **left** in the **Southern Hemisphere**
 2. The apparent deflection is strongest at the **poles** and decreases progressively toward the equator where there is zero
 3. The Coriolis effect is proportional to the speed of the object, so a **fast-moving object is deflected more than a slow one**
 4. The Coriolis effect influences direction of movement only... it has **no effect on speed**
-

Major importance of the Coriolis Effect

- All winds are affected by the Coriolis Effect
- **Ocean currents** are also deflected by the Coriolis Effect
- The **Coriolis Effect may or may not** effect the direction of the flow of the water as it drains down the sink.

